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プラズマシートから電離圏へのサブストーム擾乱の投影
Projection of substom processes from the plasma sheet to the polar ionosphere

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It has been believed that auroras observed in the ionosphere have their corresponding counterpart in the plasma sheet (Haerendel, 2011). Localized auroral breakup should reveal the location of explosive dissipation in the plasma sheet. Similar correspondence is supposed even during the growth phase. While it is well known that the prebreakup arc breakups first during the substorm, the equatorial location and relating formation mechanism of equatormost arc are long-standing questions in the understanding of the growth phase (Sergeev et al., 2012). Another aurora during the growth phase is the poleward bright arc that is believed to be an ionospheric projection of the reconnection separatrix. Also the equatorward extension of the N-S auroral arc has been suggested to be associated with eathward fast bursty flows (Nishimura et al., 2010). The region of aurora indicates that the width of oval is 7^o (64^o to 71^o), near midnight just prior to the breakup. Pich angle isotropy boundary at 65.5^o is critical for the prebreakup arc, since the isotropy boundary coincides with the prebreakup arc. Seen from the structure of isotropy boundary, the breakup arc is somewhere in the transition region between the dipole-like region and the current sheet region. A phenomenon closely related to the projection of the aurora is the distribution of FAC and its tracing. A traditional understanding for the driver of disturbances is the fast flow, both for the growth phase and the onset. The BBF was expected for a wide range of activity including localized auroral brightenings, N-S auroras and streamers (Nakamura et al., 2001). At the same time, the BBF can be a source of the FAC. The cross-tail current is diverted via downward FAC into the ionosphere on the eastward side of the bubble and is connected to upward FACs west of the bubble. The overall region 1-sense FACs is expected to emerge from 64^o to 70^o (Yang et al., 2012). The plasma ahead of the bubble is compressed, resulting in a high plasma pressure and the region 2-sense FACs that are as thin as 1^o, centered at 63^o.

Recent M-I coupling simulation reproduces almost all signatures of the substorm, including the preonset arc, and the onset that start from the low-latitude side of the oval (Tanaka et al., 2010). From the numerical solution just prior tp the onset, the BBF region from x=-10 Re to x=-20 Re in the plasma sheet is projected down along the magnetic filed to a quite narrow region in the ionosphere from 65.7^o to 66.8^o latitudes. Even the outmost field line of the plasma sheet is traced down to 68^o latitude in the ionosphere. So that the observed high-latitude part of the oval (68^o~71^o) is outside the plasma sheet. The N-S arc that usually starts from higher latitude than 70^o cannot be the reflection of the BBF. Near the midnight, in the numerical solution, the region 1 FAC distributes from 65^o to 69^o (with strong part 67^o~68^o) and the region 2 FAC distributes from 62^o to 64^o latitude. From this result, the growth phase region 1 FAC cannot be from the plasma sheet. The result of current line tracing shows that the growth phase region 1 FAC extends into the magnetosphere as far as x=-20Re through the east-west flow shear between the tail plasma sheet and the lobe. If we look at only the latitude it is barely possible that the onset FAC strating from the lowest-latitude area of the region 1 FAC around 65^o could be from the CW that should be inside x=-10 Re (65.7^o). However, it is implausible from the current line tracing. The onset region 1 FAC is mapped to the cusp-mantle region through the near earth flow shear between the plasma sheet and the lobe. Correspondence beween the plasma sheet and the ionosphere so far believed is quite confusing. It is doubtful to consider that all auroras observed in the ionosphere have their corresponding counterpart in the plasma sheet.

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